Trigger Report

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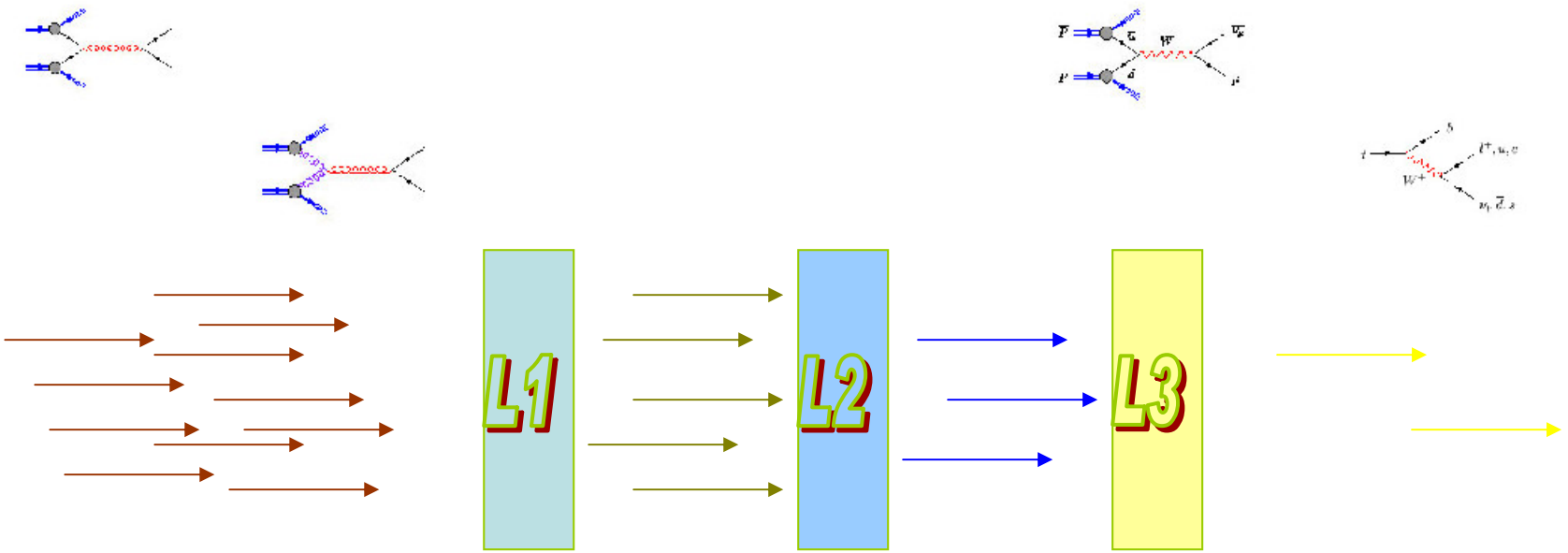


- *6.8 Million Events per second*
- *2000 Events per second*
- *1000 Events per second*
- *50 Events per second*

Current Structure of the List

- The global list is a pretty complex beast taken in it's entirety. Split it up into palatable chunks ⇨ ID objects
  - Electro-Magnetic (Volker, Marco, Ulla, Jan)
  - Muon based [di-muon, muon + jets, single muons],(Yurii, Terry, Sean, Reinhard, Marcus)
  - QCD Jet based triggers +gap triggers (Andrew, Cristophe)
  - EM-Muon triggers (Gustaff, Arnaud)
  - Multijet triggers (Gordon,Andre)
- There are currently 223 specific triggers in the list as of version 12.30. Using 114 L1 terms (max of 128).
- Currently working to expand specific trigger limit from 256 to 1024. Probably not for v13.0
- Triggers are currently being pre-scaled well ahead of schedule.

Trigger : System Capabilities

Almost there !

- L1 ⇨ L2 Rate = 1800 – 2000 Hz
- L2 ⇨ L3 Rate = 1000 Hz
- L3 ⇨ Tape Rate = 50 Hz

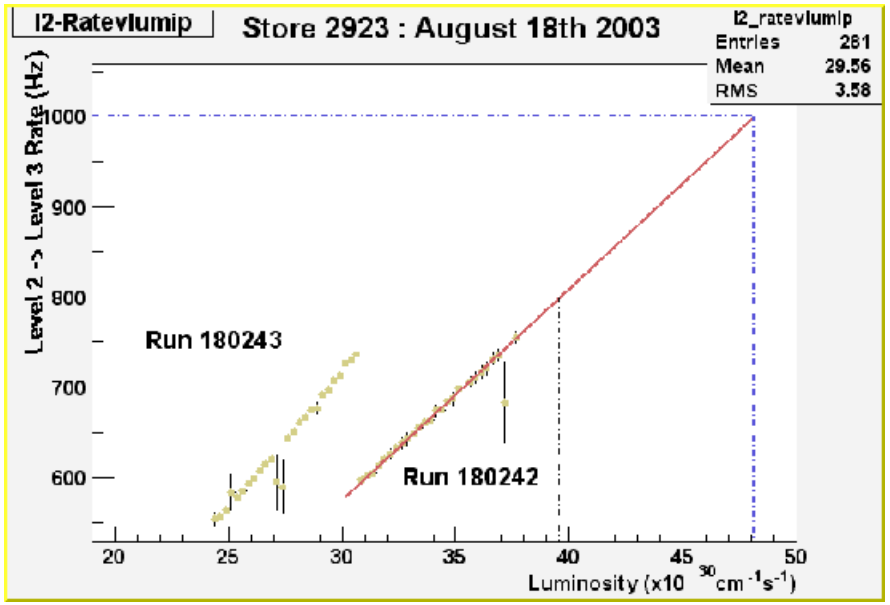
Getting Faster All the Time !

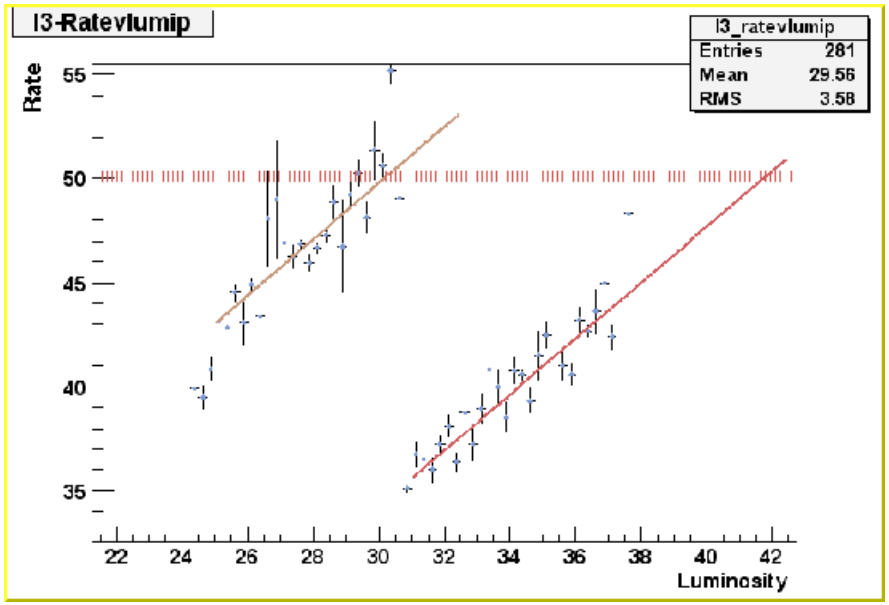
- *Better L1 to L2 Rate : Changes to sequencer timings being implemented over the shutdown.*
- *Better L2 to L3 Rate : New muon system power-pcs which I believe are in now.*

A big thankyou is in order for those people who made these increases possible !

Rate Reports : the v12 experience

- The EM ID group has expressed a desire to run unprescaled with all their sets. This just isn't possible with v12.3





- The level-3 situation also gets pretty bad at this stage. The $40x10^{30}cm^{-1}s^{-1}$ file is actually fairly *Spartan* wrt physics triggers.

Pre-Scales – putting the TM stake in

For the current settings see:-

http://wwwd0online.fnal.gov/www/groups/trigger/official/

Unfortunately a lot is getting hit now. Above 50x10^{30} cm^{-1}s^{-1} it gets really, really bad. Not a single group survives unscathed really.

Once a trigger gets out of hand (ie. Either L1/L2 or L3 rates becomes unacceptable) this generally happens. The pre-scale stake goes in. Either pre-scaled away entirely or a random number of events thrown away at L1.

Avoiding the Pre-Scale Demon

- Write triggers that have better rejections. See slides on groupings.
- … or get pre-scaled later & *deal* with it. Eos.

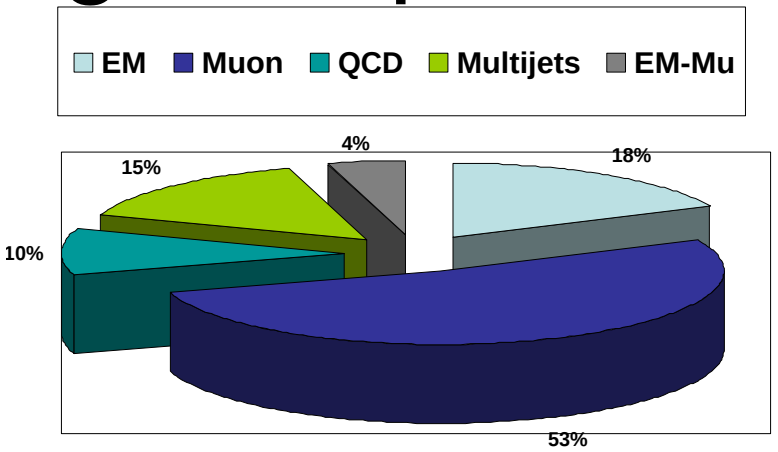
There aren't many options available after a list has been cut. Before there are though.

Before is better ……believe it or not TM's don't actually want to pre-scale away triggers.

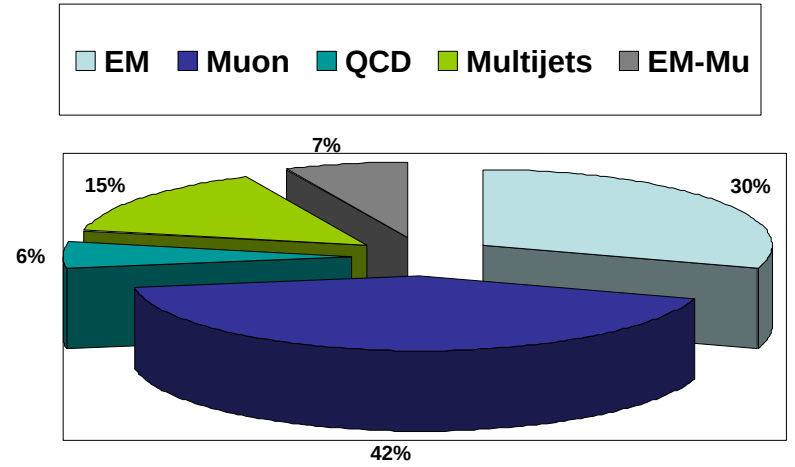
Current Splitting of L3 Bandwidth Among Groups

- The sharing between groups changes across luminosity ranges.
- Extremely useful but doesn't tell the whole story !

Low Pre-scale file
($20x10^{30}$ $cm^{-1}s^{-1}$)
Run 180451



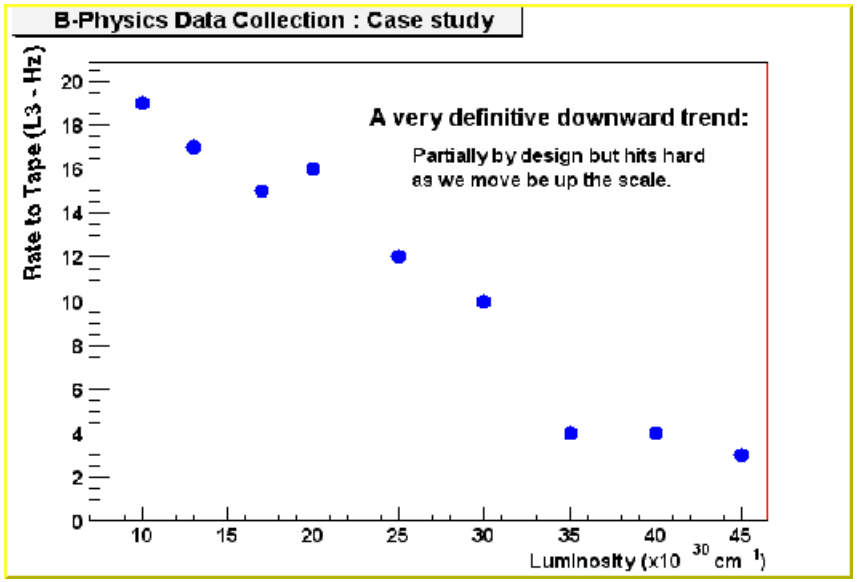
High Pre-scale file
($40x10^{30}$ $cm^{-1}s^{-1}$)
Run 180242



Further Refinements

- What the pie charts hide ……the triggers are being swapped out (some have too great a rate).

- Multiple physics programs wrapped in each set. If we work with object groupings must avoid biasing badly.

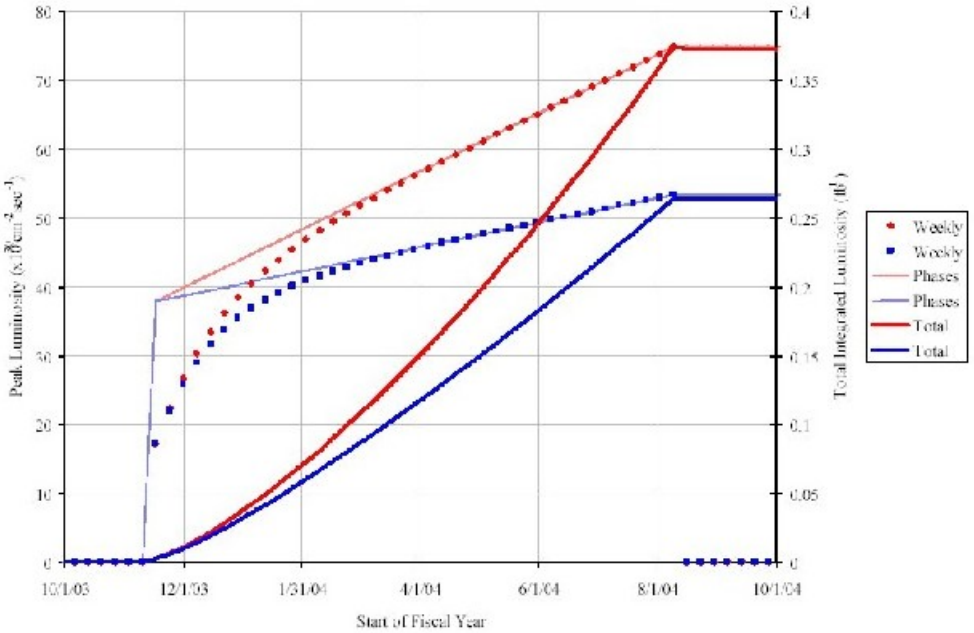


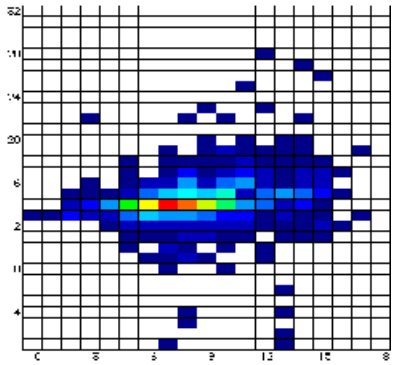
If we were to start getting high luminosities all the time it's obvious what would happen here.

From v12 to v13

- Why ? We need a list that is Luminosity *Hard*. At present we can perhaps manage 50x10^{30} $cm^{-1}s^{-1}$ with v12 before the pre-scale stake really goes in.
  - Rate problems at L2 : EM Refsets require too much bandwidth now. 1000 Hz is L2 design limit & is a hard limit.

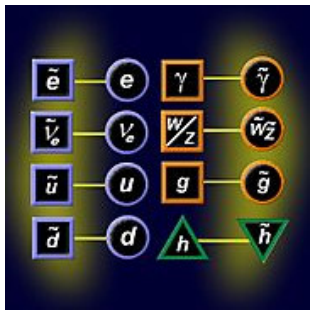
    If we went unprescaled with these we hit 1000 Hz at ~50x10^{30}.
  - Rate problems at L3 : Across the board, no simplistic solutions. EVERYONE must rationalise their trigger suite. We must be able to control rate better without pre-scales.





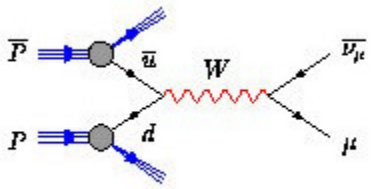
EM Refsets

- It's important to note that EM triggers are one of the main consumers of L2 bandwidth. We have options though that the EM group are looking into :-
  - TEL terms : L1 tracks matched to CPS. These will be operational within the v13 list timescale.
  - Enhanced L2 EM filter : This is the expected solution to the L2 problem. Should reduce rate by ~20/30 % at L2.
- Also L3 Improvements :-
  - Tighten track cuts and EM quality cuts. (recover ~18 %)
  - Other options available if needed (see Volker's EM talk, TB agenda 9th Oct)
- EM should be in good shape for 60-80 $x10^{30}$ $cm^{-1}s^{-1}$ with these reforms to the reference sets.



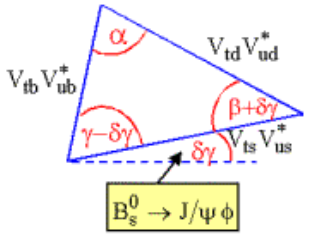
EM-Muon Triggers

- Current EM-Muon triggers target multiple event categories.
  - SUGRA tri-lepton events, anomalous GMSB with hard photon
  - WW, WH, top events
- The overall rate of the EM-Mu triggers is ~2 Hz @30E30
  - Can add track requirement to L3 EM to improve rejection in tri-lepton targeted trigger.
  - Raise thresholds or tighten quality requirements at L3 for generic EM trigger.
- Studies should be ready by the end of the month for the first v13 workshop.
- See Gustaaf B. talk given to TB on 5th September.



Muon : High momentum

- Ways to improve jet filters (Nada corrections at L3) and increase rejection from this angle are being looked into for Mu+Jets.
- Considering improvements to L3 Muon filters, using track muon matching. Try requiring medium muons at L2 to have pt > 3 GeV (local).
- Single Muon: Switch from medium muon with pt > 3 GeV to pt > 5 GeV. Expect minimal efficiency loss with extra 1-2 gain in L2 rejection. L3 track mu match, L3 filter improvements. L1CTT for Z0.
- Future Tau improvements: L1 missing Et, L2CTT, L3 muon isolation, STT
- See talks on TB pages by
    - Yurri M. , 29th August 2003.
    - Reinhard S. , 19th September 2003.
    - Yuri G. , 12th September 2003.



Muon : B-Physics

- Increase of bandwidth allocation requested for single muons higher luminosities. Of the order 1.5 Hz should not be unreasonable.
- Looking into opposite sign and mass cuts@L3 for the lower luminosity targeted triggers. Aimed at J/Psi tagging.
- Roll two high luminosity targeted triggers into one.
    - Two L1 all region muons with 2 medium muons at L2 and L3. The expected rate for this is 1.5 Hz @ 60E30.
- See Rick J. talk given to the TB on 22nd August.

Physics Capabilities: Jets and QCD-related

- The standard p-QCD triggers will be maintained. These are already more than capable of handling an increased rate.
  - Considering adopting CJT(3,5) rather than CJT(4,7) as basis for 125 GeV jet trigger. Studies pending.
  - FPD coming online after shutdown. Studies underway for utilisation of FPD in triggering.
- See A. Brandt talk on the 26th August 2003.
- Improvements to Multijet triggers
  - Add primary vertex constraint to top multi-jet trigger. Version of this trigger with a muon requirement. Top group looking into both.
  - B-tagging for supersymmetric Higgs.
  - Study L3 jets. Commonality with mu+jets effort here.
- See Gordon W. talk on 29th September 2003.

Information Available

- Most trigger related info is actually available. The trick is really knowing where to look. A good starting point is:-

  http://www-d0online.fnal.gov/www/groups/tm/tm_main.html

- If people are still using the old root-tuples for trigger studies then you should really switch to thumbnails. The old analyze packages are no longer maintained (& what is in them has no guarantees) and became the thumbnail code.
  - I will post the documentation as a D0 note. Pretty much written, just needs a few corrections before I submit it.
  - Maintained mostly by Marco V. for the time being.
  - It's accessed like any other part of the thumbnail & hence allows convenient trigger object/ offline object comparisons.

Summary

- Our trigger system is getting better all the time. We are in a very fluid situation.
  - L2 CTT now available.
  - L2 STT arriving soon.
  - New L2 EM & alphas.
  - L1 pseudo-terms (or of l1 terms).
  - L1 MET coming online, improved L1 cal calibration.
- The Tevatron IS getting better. We must get our act together for v13. It requires responsible positive action from all physics/id groups/reps. Think what embarrassing state we would be in if the Tevatron really had cranked up the luminosity this year !
- If you think you can help get our triggers into a better state, I would urge you to help. The first stage of successful analysis is successful triggering.
  - Contact your physics rep
  - Come to the Trigger Board (at least we have donuts now ! Just don't take a choccy one.. there only ever seems to be 2).
  - We will try to help.

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